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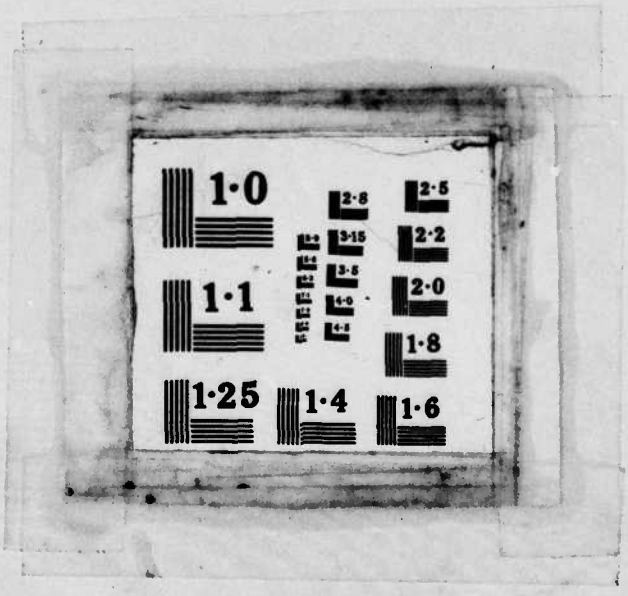

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NAVAL MARINE BASE SAN DIEGO, CALIFORNIA

FPO-1-82(17)

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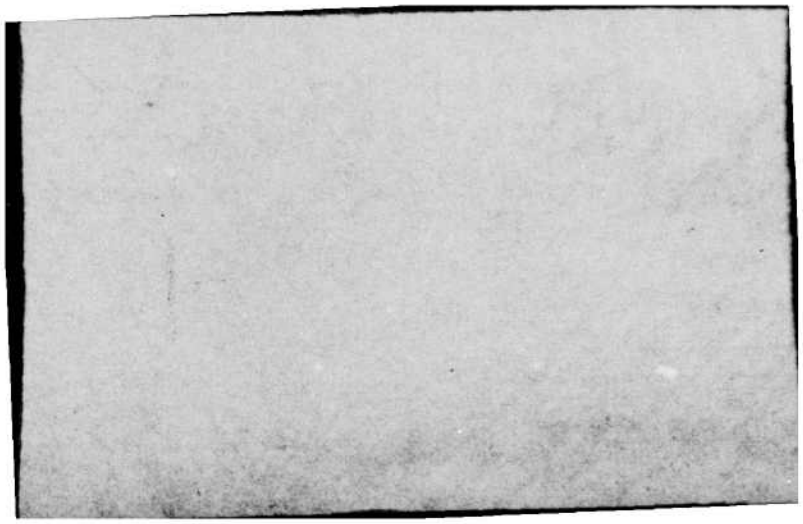

UNDERWATER FACILITIES INSPECTION AND ASSESSMENT AT

NAVAL SUBMARINE BASE SAN DIEGO, CALIFORNIA

FPO-1-82(17) SEPTEMBER 1982

PERFORMED FOR:

OCEAN ENGINEERING AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

UNDER:

CONTRACT N62477-81-C-0499
TASK 1

BY:

COLLINS ENGINEERS, INC.
600 WEST JACKSON BOULEVARD
CHICAGO, ILLINOIS 60606

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19. ABSTRACT (Continue on reverse if necessary & identify by block number)
In September, 1982, an underwater inspection was conducted at the Naval Submarine Base, San Diego, California to assess the condition of the submerged portions of the following structures: Pier 5000 (Sperry Pier), Pier 5002 (Elk River Pier), Pier 5003 (Dixon Pier), Sheet Pile Bulkhead adjacent to (Con't)

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BLOCK 19 (Con't)

Pier 5002.

A visual "swim-by" inspection was made of all facilities under investigation and a more detailed visual and tactile inspection was made of representative components of each facility. Ultrasonic thickness measurements were made of selected steel sheet piles. The detailed inspection included cleaning and scraping of selected areas of the piles and documentation of conditions with color photographs.

Generally, the underwater inspection indicated that the submerged portions of the facilities included in this project are in excellent condition.

There is, however, on concrete pile of Pier 5000, Pile 23G, that has been severely damaged above water on the underside of pile cap. This pile should be repaired.

A few minor cracks were found in three piles of Pier 5000. The cracks are not siginificant at this time, but repair of cracks using epoxy is recommended as part of future maintenance operations.

It is also recommended that, in the tidal and the splash zone, the protective coating be applied to the steel sheet piling and appurtenances of the Bulkhead adjacent to Pier 5002.

Design live loads for each facility are contained in the report. No reductions from these design loads are warranted, except in the area of Pile 23G of Pier 5000 which should be restricted to dead loads only until repaired.

EXECUTIVE SUMMARY

In September, 1982, an underwater inspection was conducted at the Naval Submarine Base, San Diego, California to assess the condition of the submerged portions of the following structures:

Pier 5000 (Sperry Pier)
Pier 5002 (Elk River Pier)
Pier 5003 (Dixon Pier)
Sheet Pile Bulkhead adjacent to Pier 5002

A visual "swim-by" inspection was made of all facilities under investigation and a more detailed visual and tactile inspection was made of representative components of each facility. Ultrasonic thickness measurements were made of selected steel sheet piles. The detailed inspection included cleaning and scraping of selected areas of the piles and documentation of conditions with color photographs.

Generally, the underwater inspection indicated that the submerged portions of the facilities included in this project are in excellent condition.

There is, however, one concrete pile of Pier 5000, Pile 23G, that has been severely damaged above water at the underside of the pile cap. This pile should be repaired.

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It is also recommended that, in the tidal and the splash zone, the protective coating be re-applied to the steel sheet piling and appurtenances of the Bulkhead adjacent to Pier 5002.

Design live loads for each facility are contained in the report. No reductions from these design loads are warranted, except in the area of Pile 23G of Pier 5000 which should be restricted to dead loads only until repaired.

The table on the following page summarizes the condition of each facility and recommended repairs with associated estimated costs.

[redacted] FACILITIES INSPECTION AND ASSESSMENT

AT

[redacted] NAVAL SUBMARINE BASE

Executive Summary Table

[redacted]	Year Built/ Extended	No. of Vertical Bearing Piles	No. of Batter Piles	Facility Size Length by Width**	Structure Type	Recommendations	Estimated Cost of Recommendations
[redacted] 1000	1961/1974*	332	122	980'-9" X 60'-0"	18" Octagon precast prestressed concrete piles	Repair Pile 23G at pile cap with formed concrete.....	$4,000
						Seal cracks in Piles 59A, 61E & 61F with epoxy (Maintenance).....	$3,000
[redacted] 1002	1978/1979	88	96	341'-10" X 60'-0"	16" & 18" Octagon precast prestressed concrete piles	No repairs recommended	N/A
[redacted] 1003	1977	127	90	517'-6 3/4" X 60'-0"	18" Octagon and 20" square precast prestressed concrete piles	No repairs recommended	N/A
[redacted] adjacent to [redacted] 1002	1978	—	—	625'-6"	Tied-back steel sheet piling	Apply protective coating to steel in tidal and splash zone (Maintenance).....	$11,000

* Year of last extension
** Overall dimensions indicated for principal [redacted] refer to plans

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UNDERWATER FACILITIES

INSPECTION AND ASSESSMENT

AT

NAVAL SUBMARINE BASE

SAN DIEGO, CALIFORNIA

1. INTRODUCTION

This report consists of the results of a detailed underwater inspection and assessment of submerged portions of the three piers and bulkheads of the Naval Submarine Base at the San Diego Naval Complex in San Diego, California.

The investigation was conducted by Collins Engineers, Inc. for the Ocean Engineering and Construction Project Office (FPO-1) of the Chesapeake Division, Naval Facilities Engineering Command (NAVFACENGCOM) as Task No. 1 of Contract N62477-81-C-0499 as part of NAVFAC's Specialized Inspection Program. The Specialized Inspection Program sponsors task-oriented engineering services for the inspection, analysis, and design and monitoring of repairs for the submerged portions of selected naval waterfront facilities.

1.1 Task Description

The task consisted of furnishing the engineering services necessary to achieve an assessment of the apparent general condition of the structural members supporting Piers 5000, 5002 and 5003, and the bulkhead adjacent to Pier 5002 at the Naval Submarine Base.

The task consisted of two phases: a field investigation phase and an assessment phase.

The field investigation phase consisted of an underwater inspection of submerged pilings and bulkheads by two-engineer divers and a technician-diver. The inspection was conducted in such detail as to permit a general assessment of the physical condition of the portions of the substructure that are submerged or subject to frequent wetting by wave or tidal action. A visual "swim-by" inspection was made of all facilities under investigation and a more detailed visual and tactile inspection was made of selected facility components. This detailed inspection included scraping and cleaning of the components.

The "swim-by" inspection was conducted in accordance with the government's guidelines for Level I inspections, and the detailed inspection was conducted in accordance with the guidelines for Level II Inspections. Those levels of inspection are defined below.

Level I: General Inspection: This type of inspection is essentially a "swim-by" overview, which does not involve cleaning of any structural elements, and therefore can be conducted much more rapidly than the other levels of inspection. The Level I inspection should confirm as-built structural plans and detect obvious major damage or deterioration due to overstress (collisions, ice), severe corrosion, or extensive biological attack. The underwater inspector shall generally rely primarily on visual and tactile observations to make condition assessments. Visual documentation (utilizing underwater television and/or photography) may be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility condition.

Level II: Detailed Inspection: This type of inspection will often require prior cleaning of the structural elements. The purpose of the Level II inspection is to detect surface damage which may be hidden by marine

growth and/or deteriorated surface material. Generally, cleaning is time-consuming, and therefore is generally restricted to areas that are critical or which may be representative of the entire structure itself. The amount and thoroughness of cleaning to be performed is governed by what is necessary to discern the exterior physical condition of the structural members, and to rapidly obtain nominal measurements by means of simple instruments such as calipers, measuring tapes, and ice picks. This level of assessment should identify areas that have been mechanically damaged or are in advanced states of deterioration. Visual documentation (utilizing underwater television and/or photography) and a sampling of physical measurements should be included with the quantity and quality adequate for documentation of the findings which will be representative of the facility condition.

The assessment phase of the investigation consisted of documenting the configuration of the existing structures; summarizing the conditions encountered during the field inspection; evaluating their structural significance; and recommending actions that should be taken to insure long-term, cost-effective maintenance and utilization of the facilities. Estimated costs for repairs were also developed.

1.2 Report Content

The report contains a description of the Naval Submarine Base and its facilities including location; mission; and environmental data including topographic, climatic, soils, and seismic features along with a discussion of the inspection procedures. The report also contains the results of the inspection and the assessment of the findings, accompanied by pertinent drawings and photographs. The inspection results include a description of the structural configuration of each facility along with its apparent condition and a structural assessment of the conditions found. Recommendations including cost estimates for any repair work are also included.

2. ACTIVITY DESCRIPTION

2.1 Name of Activity

Naval Submarine Base, San Diego, California.

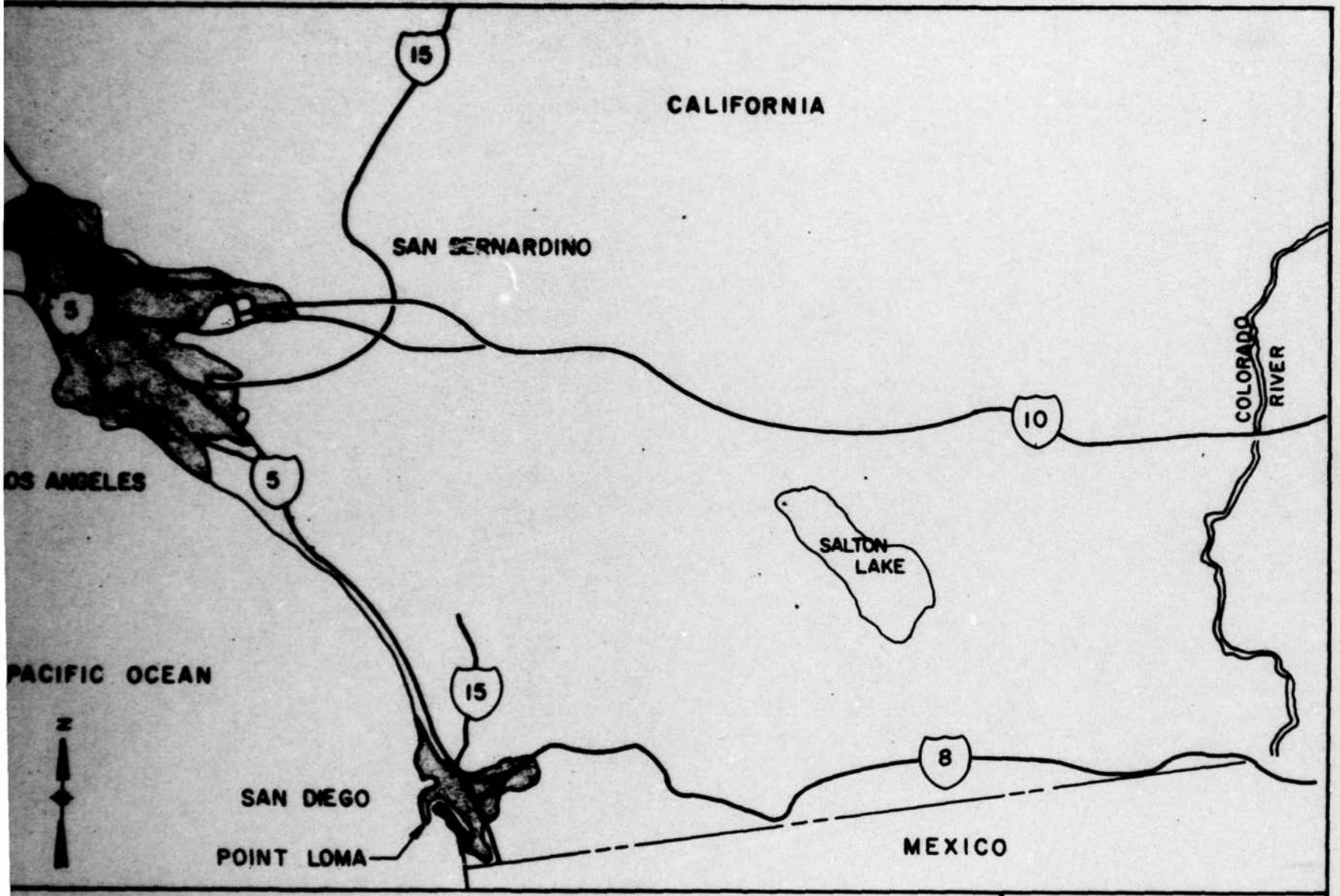
2.2 Location of Activity

The Naval Submarine Base is located within the City of San Diego, San Diego County, California, on Point Loma. The facility lies on the west side of the entrance to San Diego Bay on the historic Ballast Point, seven miles from downtown San Diego. The Naval Submarine Base is located approximately 16 miles from the Mexican border as shown on Figure 1 following this page.

San Diego Bay is one of the great natural harbors of the world. The harbor covers about 18 square miles and has a mean tidal range of approximately seven feet. The main channel inside the harbor averages 2,000 feet in width and varies from 36 to 75 feet in depth at mean low water. The anchorage area is seven miles long, 2,000 feet wide, and has a depth of from 30 to 50 feet.

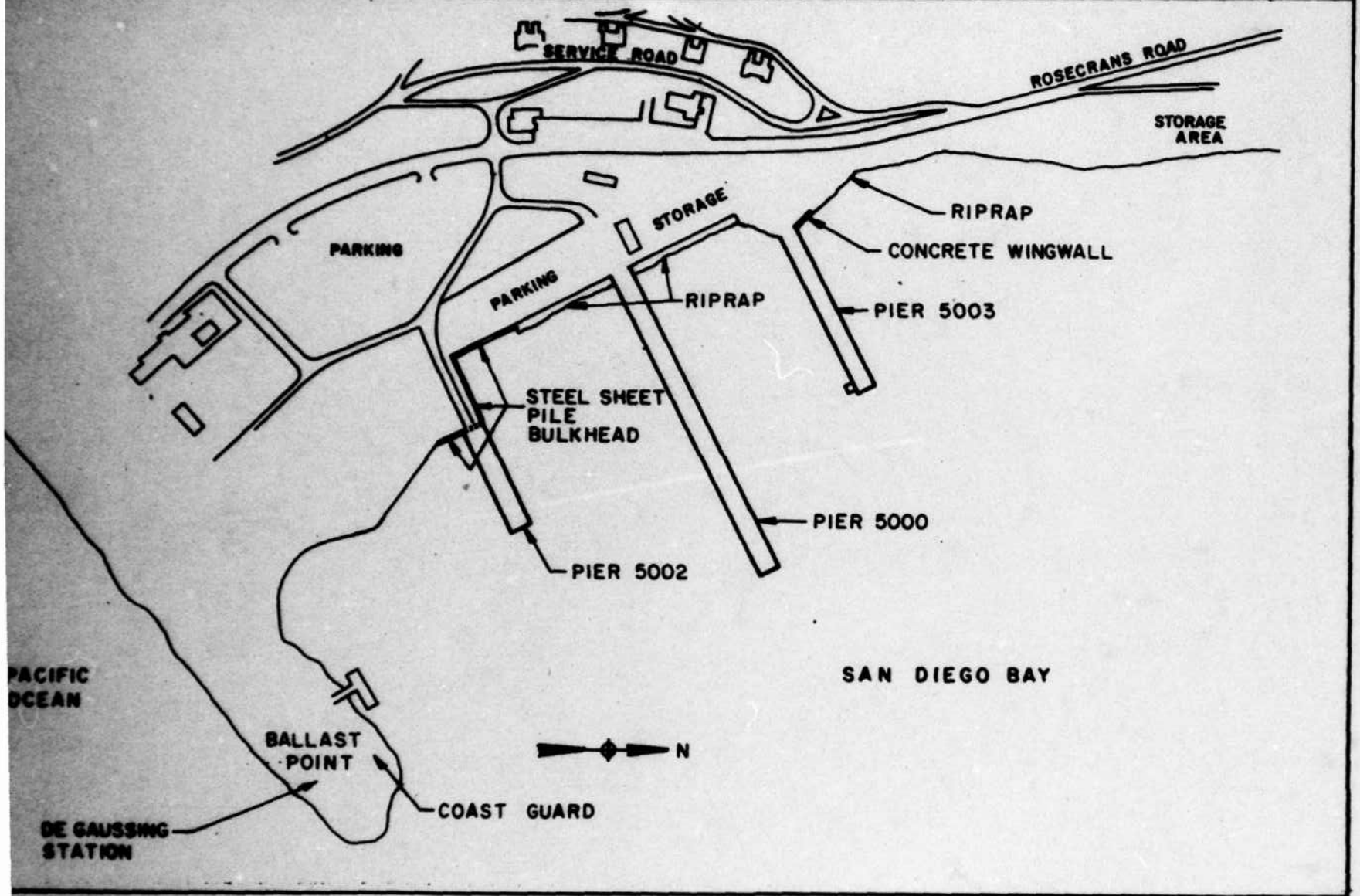
The southern extension of Ballast Point forms a natural breakwater, providing deep draft and calm surface conditions which are essential to submarine berthing. The location close to the harbor entrance provides quick and easy access to the sea.

Surrounding properties include the Cabrillo National Monument on the south, Rosecrans National Cemetary and the Naval Electronics Laboratory Center on the west, and the Naval Supply Center Fuel Department and Naval Station Degaussing Department on the north. Figure 2, on Page 2-3, is an overall view of the facility.



LOCATION MAP
NAVAL SUBMARINE BASE
SAN DIEGO, CALIF.

FIGURE 1



FACILITY MAP
NAVAL SUBMARINE BASE
SAN DIEGO, CALIF.

FIGURE 2

2.2 Mission of Activity

The mission of the Naval Submarine Base is to provide and operate shore facilities to support the ships and personnel assigned to the West Coast representative of the Submarine Force, U.S. Pacific Fleet. It is the home port for the Commander of Submarine Group Five. Berthing and logistic support are provided for approximately thirty ships. The average in-port berthing requirement is for sixteen submarines (SS/SSN), two submarine tenders (AS), one submarine rescue ship (ASR), one floating dry dock (ARD), and one ocean tugboat (AFT).

2.4 Description of Activity

This program is concerned with the waterfront facilities which provide the interface between ships and shore support activities. The principal waterfront facilities are shown in Figure 2. The table below identifies the principal facilities.

Facility	Facility No.	Yr. Built/Extended	Length
Pier 5000 (Sperry)	P-998	1961/1974*	981 ft
Pier 5002 (Elk River)	P-020/P-041	1970/1979	342 ft
Pier 5003 (Dixon)	P-997	1977	518 ft
Bulkhead	P-020	1970	625 ft

* Date of last extension

2.5 Environmental Data

2.5.1 Topography

The San Diego metropolitan area lies almost entirely within the coastal plain terminated by the Peninsula Range to the east. The coastal plain, varing in width from ten to

twenty miles, has irregular topography characterized more by rolling hills than mesas. Mt. Woodson, rising 3,894 feet, is the highest area within the metropolitan area.

The terrain within the San Diego Naval Complex rises gradually from the ocean through a series of low ridges, hills, and canyons to the eastern end of the complex where the elevation averages approximately 500 feet above sea level.

2.5.2 Climate

The climate in the San Diego area is relatively mild with a small range in temperature. This mild, even climate is one reason San Diego is an ideal place for year-round military training exercises and a pleasant place for military personnel to retire.

Average monthly maximum air temperatures range from about 63°F in January to 79°F in August. Average monthly minimum air temperatures range from about 46°F in January to 66°F in August. Record extreme air temperatures are 30°F and 111°F.

Ocean water temperatures range from about 69°F in the summer months to 50°F in winter.

The mean monthly precipitation ranges from a low of 0.25 inches to a high of 2.0 inches. Relative humidity ranges from an annual low of 54 percent to a high of 82 percent. Sky conditions are clear for about 30 to 55 percent of the time.

Tidal Range at the Site is as Follows:

Extreme High Water	8.1
Mean Higher High Water	5.8
Mean High Water	5.1
Mean Low Water	0.9
Mean Lower Low Water	0.0
Extreme Low Water	-2.6

2.5.3 Soils Characteristics

The soils in the San Diego region have for the most part developed from Pleistocene marine terrace deposits. They vary from loamy sand to coarse sand in texture and are neutral to slightly acid in ph. These soils exhibit high permeability and a low natural fertility. Occasionally the shallow surface soils are underlain by interspread clay layers, hard pan or marine sandstone. The surface soils, in general, are very erodible, especially where ground cover is poor. Many of the soils on the coast are "man-made", the result of early and varied dredging and landfill operations.

On the bay side of Point Loma an old and extensive landslide area is present. This area has become active again within the last twenty-five years. This area covers approximately 35 to 40 acres and would require stabilization work of substantial magnitude before further sliding would not endanger shore based installations.

2.5.4 Seismic Activity

The City of San Diego does not lie directly atop a known earthquake fault; however, its location, 80 miles from the San Andreas Fault, 60 miles from the San Jacinto Fault, and 40 miles from the Elsinore Fault, places the city in Seismic Zone 4, the zone having the highest damage susceptibility. Although, to date, none of the earthquakes experienced in the area have been damaging, the possibility exists of a major earthquake occuring.

3. INSPECTION PROCEDURE

Between August 30, 1982 and September 3, 1982 an underwater inspection of submerged pilings and bulkheads was performed by a team of engineer-divers and a technician-diver at the Naval Submarine Base at San Diego, California. The inspection was conducted in such detail as to permit a general assessment of the physical condition of the portions of the substructure that are submerged or subject to frequent wetting by wave or tidal action.

The level of inspection required and the type of structures to be inspected, required the selection of inspection tools and methods that were effective and efficient. The techniques were selected to yield sufficient information to make a general assessment of the supporting structures of each facility; identify areas of significant damage or deterioration; and determine rates of deterioration through non-destructive testing.

3.1 Level of Inspection

Refer to Section 1.1 for a definition of Level I and Level II inspections.

A Level I inspection was conducted of all accessible underwater structural elements.

A Level II inspection was conducted in areas of apparent damage or deterioration, and at selected locations. The following is a summary of the extent of detailed inspection conducted at each facility:

Pier 5000	Cleaning and scraping of 49 concrete piles
Pier 5002	Cleaning and scraping of 19 concrete piles
Pier 5003	Cleaning and scraping of 22 concrete piles
Bulkhead adjacent to Pier 5002	Cleaning and scraping of 6 steel sheet piles

The concrete piles were scraped and cleaned in a band at least 10 inches wide on three sides of the pile. The location of the band was randomly selected between the mudline and mean low water. Most piles were cleaned in one location; a few were cleaned at two locations.

The selected steel sheet piles of the bulkhead were cleaned and scraped in two areas approximately 6 inches square. One area was near the mudline and the other area was near mean lower low water.

Representative as well as unusual conditions observed during the Level I and Level II inspections were documented with underwater color photographs.

3.2 Inspection Procedure

A detailed underwater inspection was made of the accessible portions of the facilities described above. The inspection included the concrete bearing and batter piles, and steel sheet piling of these facilities from the area near the waterline at the time of the inspection to the channel bottom.

The underwater inspection was conducted by a three person team, including two engineer-divers and a technician-diver. The diving and tending duties were rotated among the team members. The divers, using scuba equipment, worked from a small boat supplied by the facility.

In making the "swim-by" (Level I) inspection, at least two divers were in the water near each other. A tender in the boat observed and coordinated the divers' work. The "swim-by" inspection generally consisted of the divers descending individual piles, circling around the piles while inspecting them. Upon reaching the bottom, the divers swam to the next piles and ascended while circling and inspecting them.

At the surface the divers reported the general conditions encountered to the tender/notekeeper. The divers would then proceed to the next set of piles. If the diver

encountered any significant distress or deterioration they would surface immediately and report their findings to the tender/ notekeeper.

During the "swim-by" inspection, selected elements of the facility were given a more detailed visual and tactile inspection (Level II). The detailed inspection included cleaning and scraping, and sounding and probing as necessary to determine the condition of the pile.

The steel sheet piling bulkhead was inspected using the "swim-by" method and a more detailed visual and tactile inspection was performed at approximately 100 foot intervals. The detailed inspection included cleaning and scraping a six inch square area, and taking ultrasonic thickness measurements at two elevations: near the mudline, and at mean lower low water.

Underwater photography, as well as detailed notes and sketches, was utilized to document the conditions encountered in the inspection. Also, an on-site report of the progress of the inspection was made on a daily basis to the on-site government representative.

At each facility, the diver scraped and cleaned representative areas to conduct Level II inspections during the Level I inspection. The Level I and Level II inspections were generally conducted at the same time. The photography was completed at a later time.

3.3 Inspection Equipment

During the inspection, various pieces of equipment were used to accomplish different tasks. A sounding line was used to determine the channel bottom along the facilities. Scrapers and chipping hammers were used to clean the piles, and a 12-foot tape was used to measure any defect encountered. A Nikonos III Underwater Camera with a 28mm lens and an Ikelite Substrobe 150 was used to document the inspection findings.

A Krautkramer D-meter ultrasonic thickness gauge, DM-2, was used to measure the thickness of the steel sheet piling bulkhead. This was accomplished after first cleaning the steel sheet piling with scrapers.

Miscellaneous, minor equipment included dive lights, knives, scrapers, and marking crayons.

4. FACILITIES INSPECTED

Each facility inspected at the Naval Submarine Base is discussed separately in the following sections. The discussion for each facility is presented in four parts:

1. A description of the structural configuration,
2. A discussion of the conditions observed during the inspection.
3. An assessment of the structural condition,
4. Recommendations to ensure long term serviceability.

In the sections which describe the structural configuration of each facility, the figures included were developed from available drawings and inspection notes. These figures may be found on the page or pages immediately following the descriptive section. Their general conformance with actual field conditions was verified by visual observations and measurement.

Design load data, where available is summarized for each structure.

The pier facilities are protected from vessels by timber fender pile systems and camels.

The underwater visibility at the time of the inspection averaged from six to eight feet. All water depths described in the following sections are referred to Mean Lower Low Water, Elevation 0.00.

Detailed breakdowns of the cost estimates for recommended repair and maintenance are included in the Appendix.

The marine growth profiles for Piers 5000, 5002, and 5003 are similar from mean low water to the mudline. In general, the piles are covered with barnacles, mussels, sponges, and terrestial turf, an interwoven mixture of plants, stems, roots, soil and skeletal structures of invertebrates. The growth in thickness varied from four inches to eight inches, and generally was about six inches thick. The density and thick-

channel bottom. The encrustations were firmly attached to the piles, and generally they had to be individually hammered or scraped to remove them. Only the piles of the 1979 extension of Pier 5002 could be cleaned by broad sweeps of the scraper.

Growth thins out in the tidal zone to a thin covering of barnacles.

Local areas of sponge and coral were present, and starfish and crabs were found on some piles. Refer to Photographs 1 through 6 for typical examples of marine growth.

The channel bottom is generally sandy, silty, and sparsely covered with marine growth. In some areas, kelp vines were also present.

4.1 Pier 5000

4.1.1 Description

Pier 5000, the largest pier at the Naval Submarine Base, is commonly referred to as Sperry Pier. It provides berthing space for submarine support vessels on each side, and at its outboard end.

The inboard end of Pier 5000 was built in 1961 and it has been extended twice, most recently in 1974.

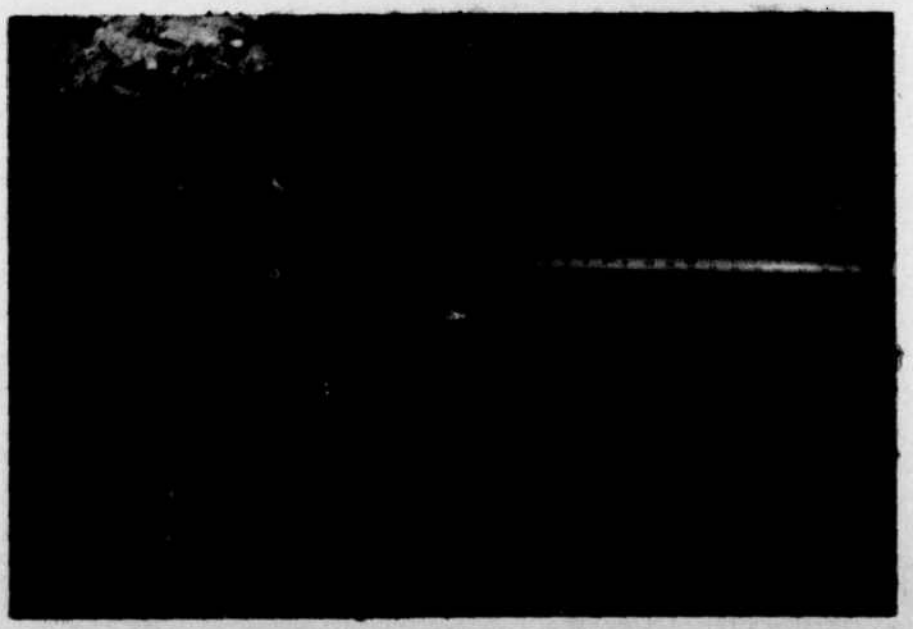
Pier 5000 is approximately 981 feet long and 60 feet wide. The pier is generally constructed of precast, pre-stressed concrete vertical and batter piles with a precast concrete pile cap supporting precast concrete panels. A cast-in-place concrete topping is supported by the precast panels. Between Bents 58 and 62, the pile cap and concrete slab were constructed of cast-in-place concrete. The pier is protected from vessels by a timber pile system.

The water depth along the pier generally varies from approximately 35 to 40 feet.

PHOTOGRAPH 1 TYPICAL MARINE GROWTH, PIER 5000 AT APPROXIMATELY -20 MLLW

PHOTOGRAPH 2 TYPICAL MARINE GROWTH, PIER 5000 AT APPROXIMATELY -10 MLLW

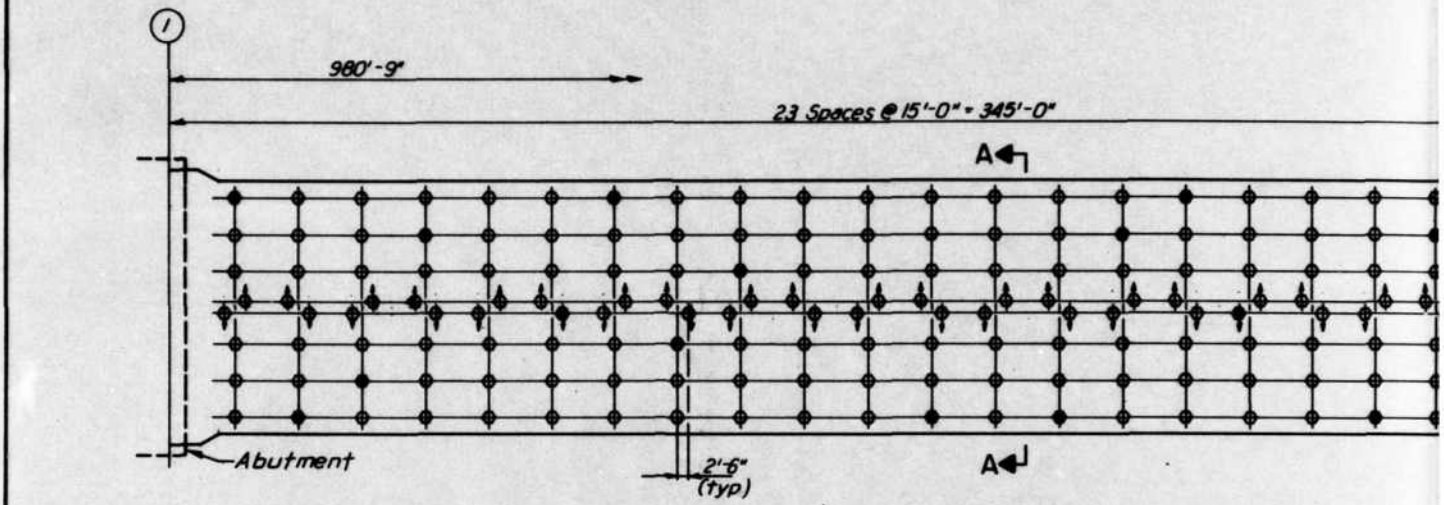
PHOTOGRAPH 3 TYPICAL MARINE GROWTH, PIER 5002

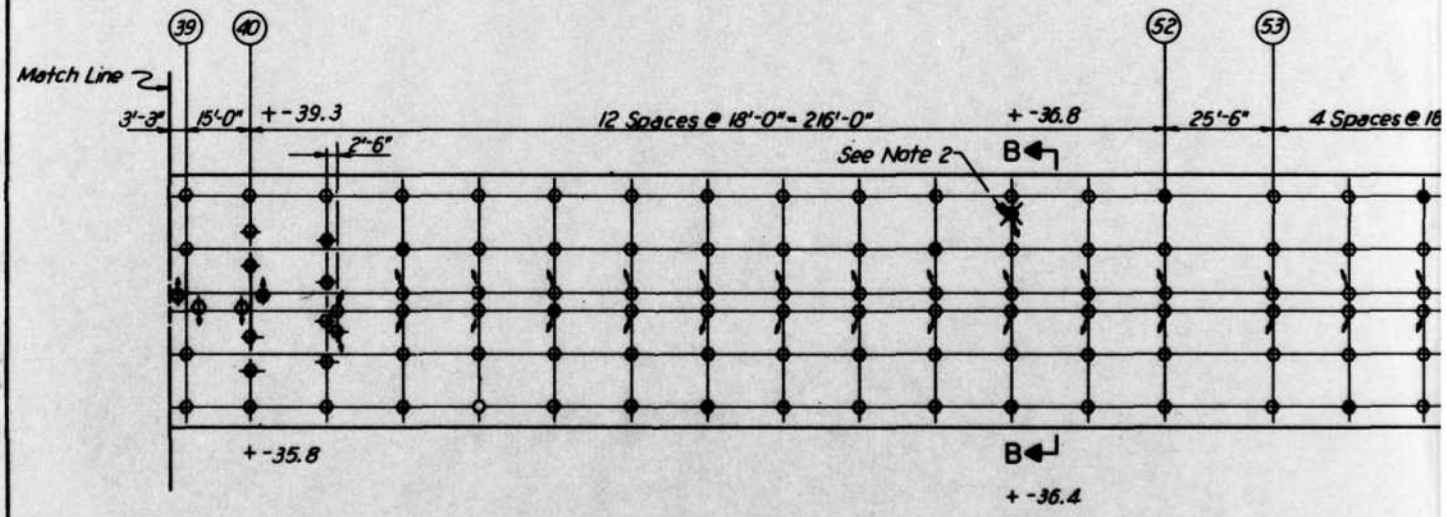


PHOTOGRAPH 4 TYPICAL MARINE GROWTH, PIER 5003 AT APPROXIMATELY -30 MLLW

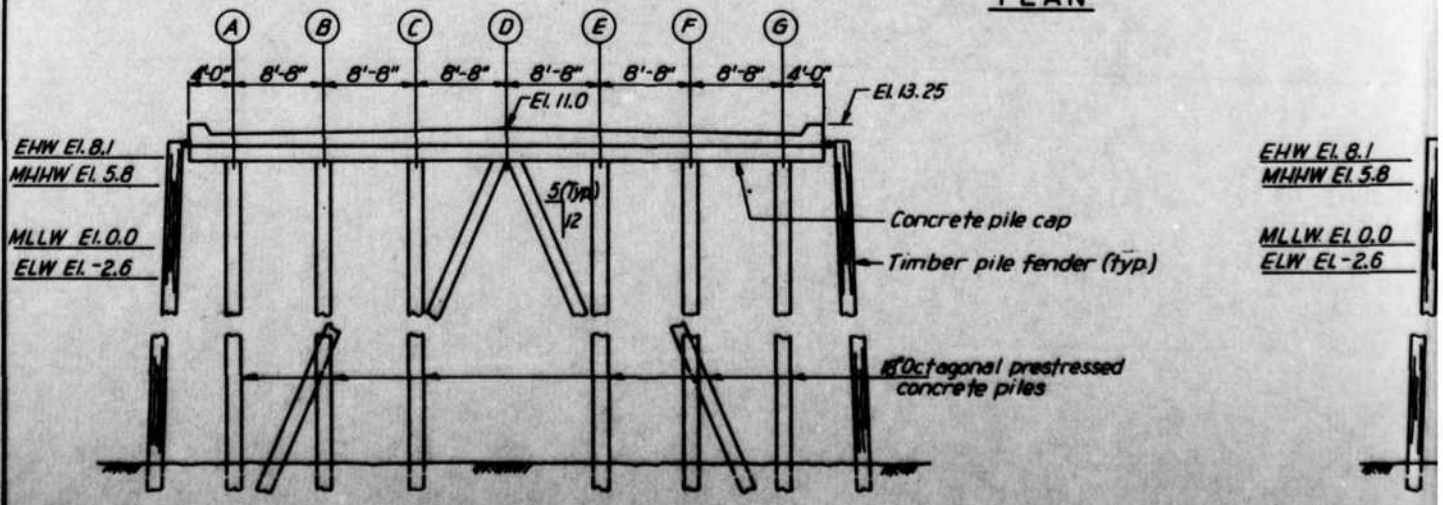
PHOTOGRAPH 5 TYPICAL MARINE GROWTH, PIER 5003 AT APPROXIMATELY -10 MLLW

PHOTOGRAPH 6 TYPICAL MARINE GROWTH, PIER 5003 IN TIDAL ZONE

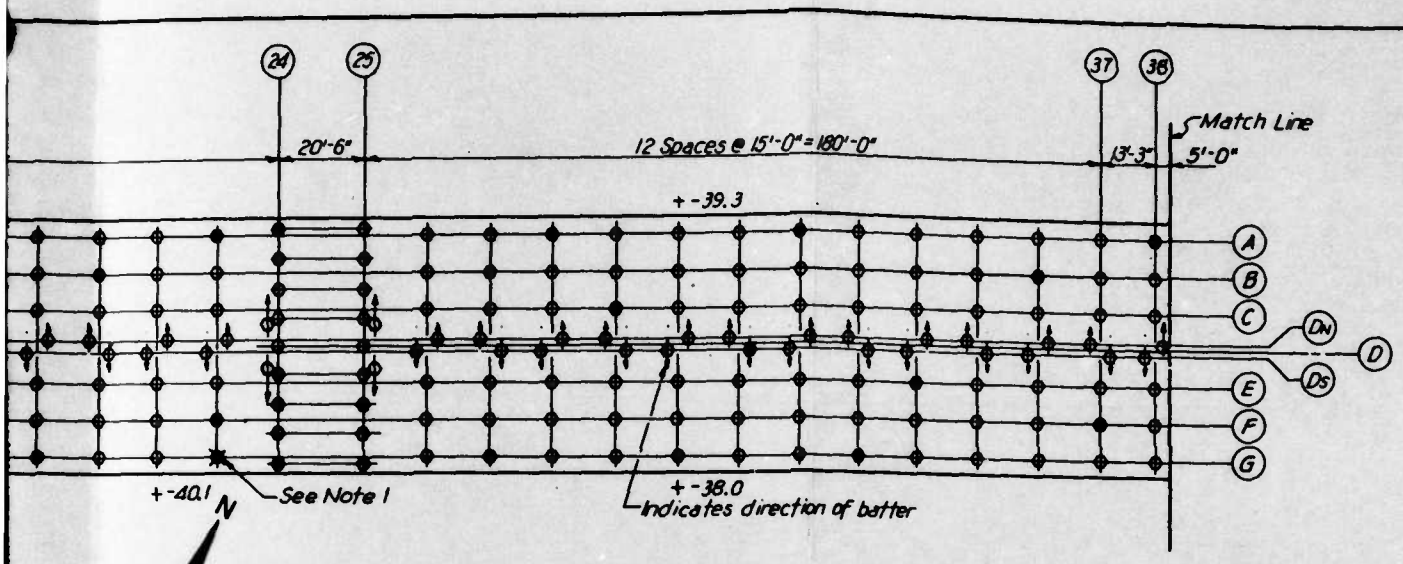


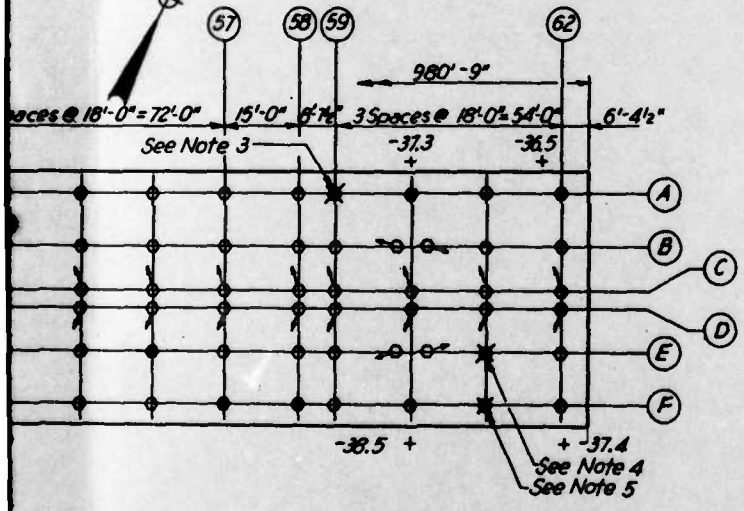


PLAN



SECTION A-A





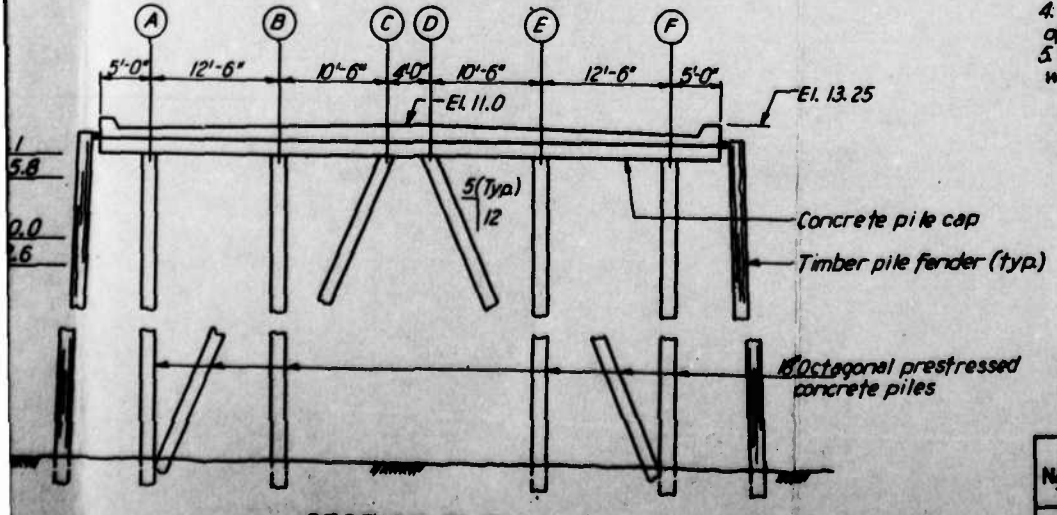
DESIGN LOADS:
Live Load: H20-S16+15% Impact;
600 psf uniformly distributed;
30 Ton Truck Crane.

GENERAL NOTES:
This drawing developed in part from NAVFAC Drwg. No. 6015241 & 603282 and Y & D Drwg. No. 923124

All piles were given a "swim-by" Level I inspection; piles that are shaded were given a detailed Level II inspection.

+ Channel bottom elevations
Datum MLLW El. 0.00
▣ Indicates damaged piles

NOTES:
1. Pile concrete broken at connection to pile cap.
2. Pile broken off 6 ft. below MLLW.
3. Vertical crack in North face of pile; ⅛ in. wide from 15 ft. - 25 ft. below MLLW.
4. Vertical hair line crack in South face of pile; 3 ft. - 10 ft. below MLLW.
5. Vertical crack in South face of pile ⅛ in. wide; 5 ft - 12 ft. below MLLW.



SECTION B-B

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

NAVAL SUBMARINE BASE SAN DIEGO, CA.

PIER 5000

2

4.1.2 Observed Inspection Condition

The prestressed concrete piles of Pier 5000 are generally in excellent condition. When cleaned of marine growth, the concrete appeared sound and the corners were sharp and hard.

One severely damaged pile, however, was found. Pile 23G was damaged above water at the underside of the pile cap. The concrete of approximately the top six inches below the pile cap was broken and missing. The reinforcing steel in the pile was exposed and bent, but no steel was severed. Figure 4 below, in which only some of the steel is shown, illustrates the damage. No further damage was noted underwater.

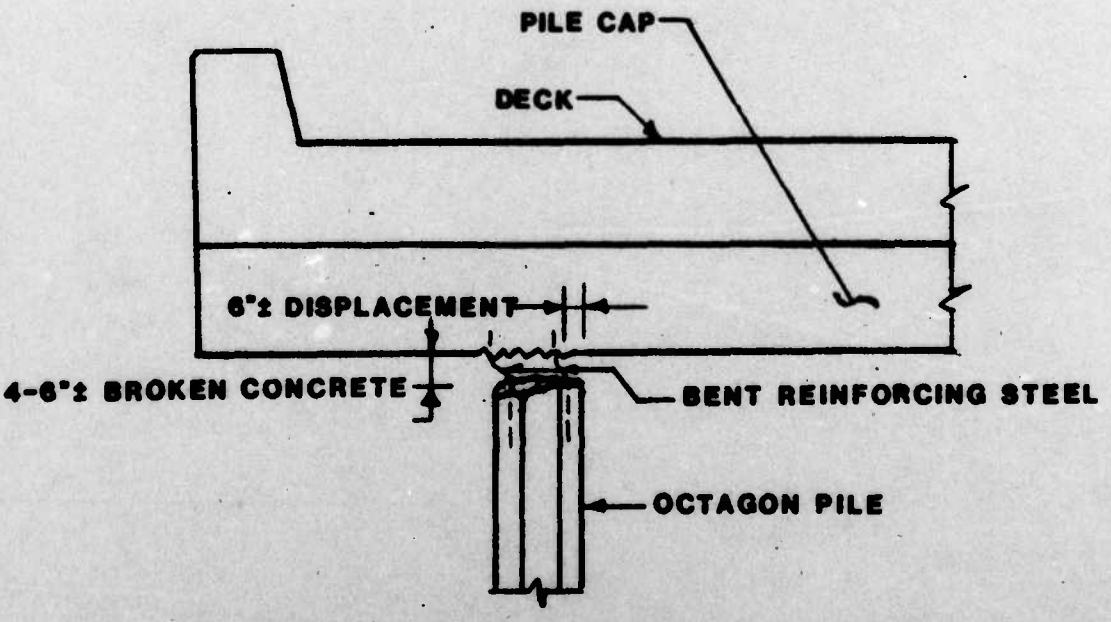


FIGURE 4 PILE 23G

Three piles (Piles 59A, 61E, and 61F) near the outboard end of the pier had vertical cracks ranging from hair-line width to one-eigth inch width. One crack, from 7 to 10 ft long, was found on each pile. Refer to Photograghs 7 and 8 for views of two of these cracks.

Immediately south of Pile 50A, there is a section of pile that extends from the pile cap to about 6 ft below mean lower low water. There is no other evidence of this pile below water. This appears to be an extra pile, since it does not conform to the adjacent pile pattern as shown on the design drawings.

Refer to Photographs 9 through 11 for views of typical piles of Pier 5000.

Rubber tires had been dropped over a number of the vertical piles of Bents 1-6 prior to installing the pile cap. These tires generally rest on the channel bottom.

4.1.3 Structural Condition Assessment

Pier 5000 is in excellent condition, except for the damaged Pile 23G. No other significant structural damage or deterioration of the pier was observed.

The cracks noted in the piles near the outboard end of the pier are not structurally significant at this time, nor does it appear that the cracks are new or progressing.

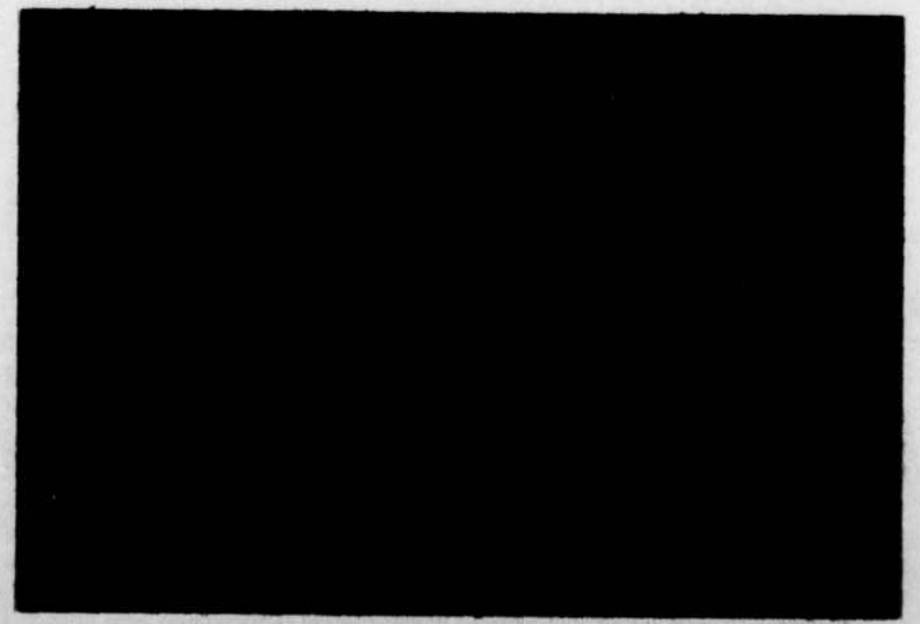
The section of short pile adjacent to Pile 50A does not appear to be structurally significant.

4.1.4 Recommendations

It is recommended that Pile 23G be repaired. One method of affecting that repair would be by removing a small portion of the concrete deck and pile cap in the area of Pile 23G; re-forming the concrete pile cap around the pile in its present position; installing additional reinforcing steel; and replacing the portion of the concrete deck that was removed. The repair of

PHOTOGRAPH 7 VERTICAL CRACK IN PILE 59A, PIER 5000

PHOTOGRAPH 9 PILE 54F AT APPROXIMATELY -20 MLLW, PIER 5000



PHOTOGRAPH 11 PILE 49B AT APPROXIMATELY -20 MLLW, PIER 5000

the pile and pile cap might also be accomplished without the removal of the deck by working from a floating stage under the pier. Using either procedure, all work could be accomplished above water. It is estimated that this repair could be accomplished for approximately $4,000.

It is recommended that no vehicle, equipment, or storage loads be permitted within approximately 20 ft. of Pile 23G until the pile is repaired.

It is also recommended that, as a part of future preventative maintenance, the cracks in Piles 59A, 61E, and 61F be sealed above and below water with an epoxy grout. Although the structural capacity of these piles has not been significantly affected at this point, the cracks could provide an avenue of entry for future deterioration. The estimated cost of this maintenance work is approximately $3,000.

No reduction from the design live loads indicated on Figure 3 is recommended, except for the temporary restriction of loads in the area of Pile 23G.

It is further recommended that another inspection of Pier 5000 be conducted in five years. Particular attention should be given to the cracks found in the three octagon piles to determine if deterioration is progressing. This report should be used as a reference base against which to judge future conditions.

4.2 Pier 5002

4.2.1 Description

Pier 5002, the southernmost pier at the Naval Submarine Base, is commonly known as Elk River Pier. It provides berthing space for submarine support vessels at its outboard end, and provides berthing space for submarines, and miscellaneous yard and small craft along its sides.

The inboard end of the pier, Bents 1 through 7, was constructed in 1970. The outboard end, Bents 8 through 23, was built in 1979.

Pier 5002 is approximately 342 feet long and 60 feet wide. The pier is constructed of precast, prestressed concrete vertical and batter piles with a cast-in-place concrete pile cap supporting precast concrete panels. A cast-in-place concrete topping is supported by the precast panels. The pier is protected from vessels by a timber fender pile system.

The water depth along the pier varies from approximately 5 feet at the inboard end to 44 feet at the outboard end.

Refer to Figure 5 for a plan of the pier and typical sections showing the configuration of the structure.

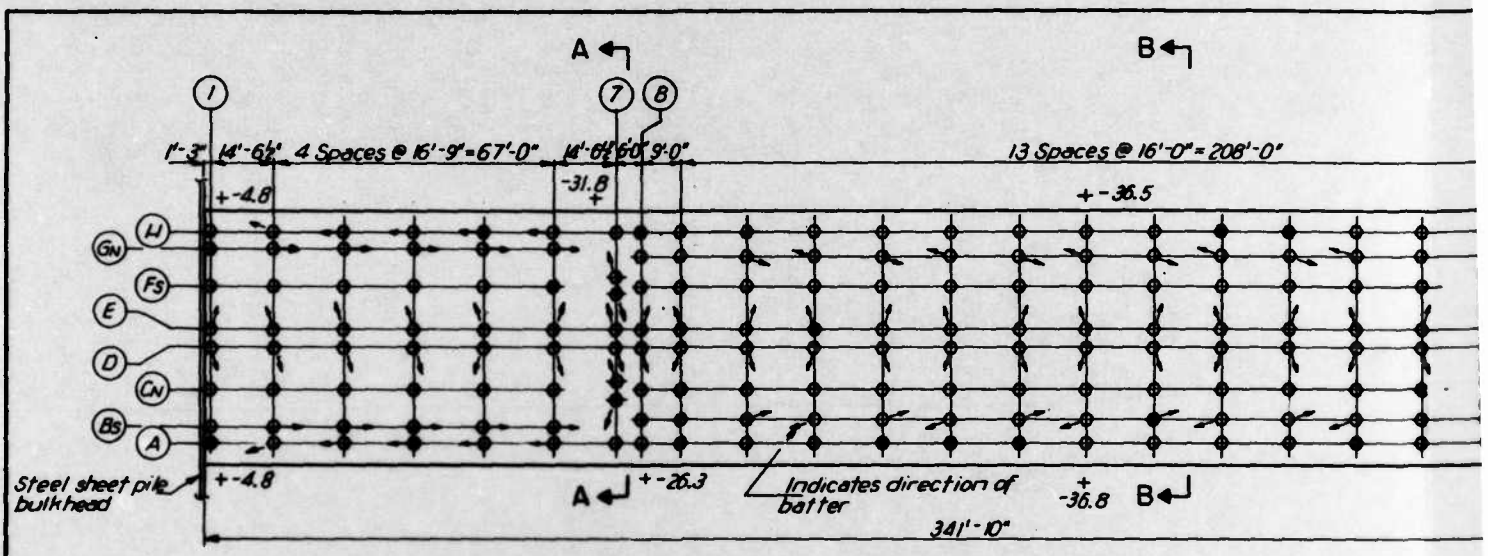
4.2.2 Observed Inspection Condition

The prestressed concrete piles of Pier 5002 are in excellent condition. When cleared of marine growth, the concrete appeared sound and the corners were sharp. Refer to Photographs 12 and 13 for views of typical piles.

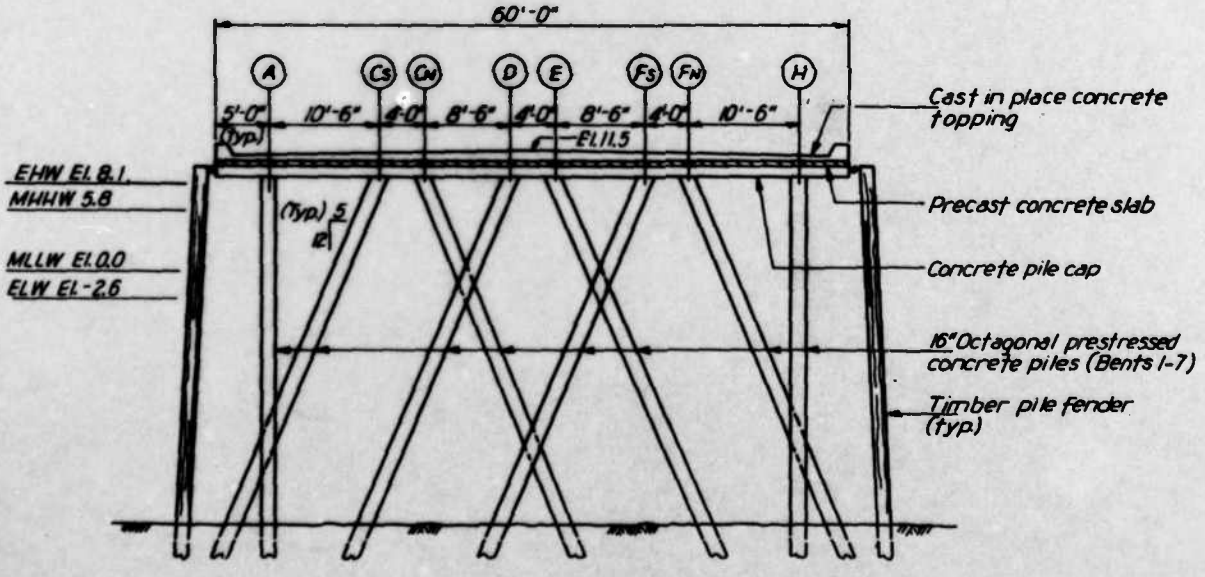
4.2.3 Structural Condition Assessment

Pier 5002 is in excellent condition. No significant distress or deterioration was found.

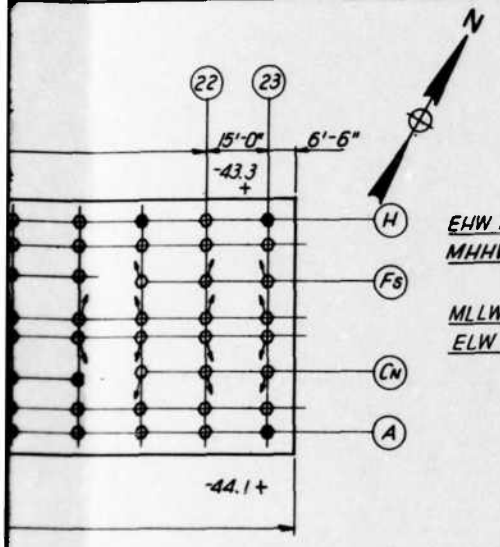
4.2.4 Recommendations

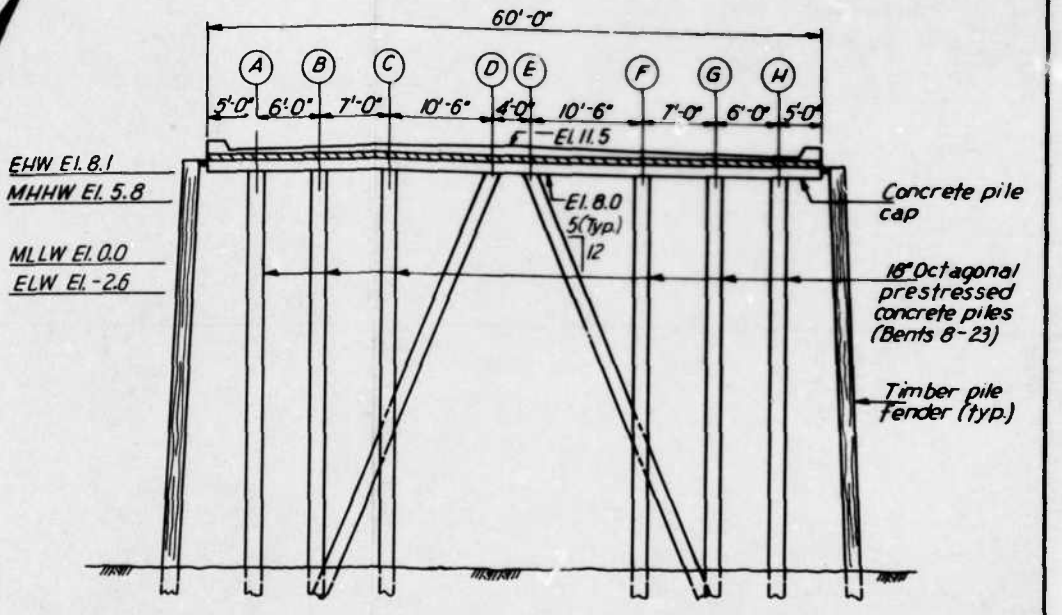


PLAN



SECTION A-A





SECTION B-B

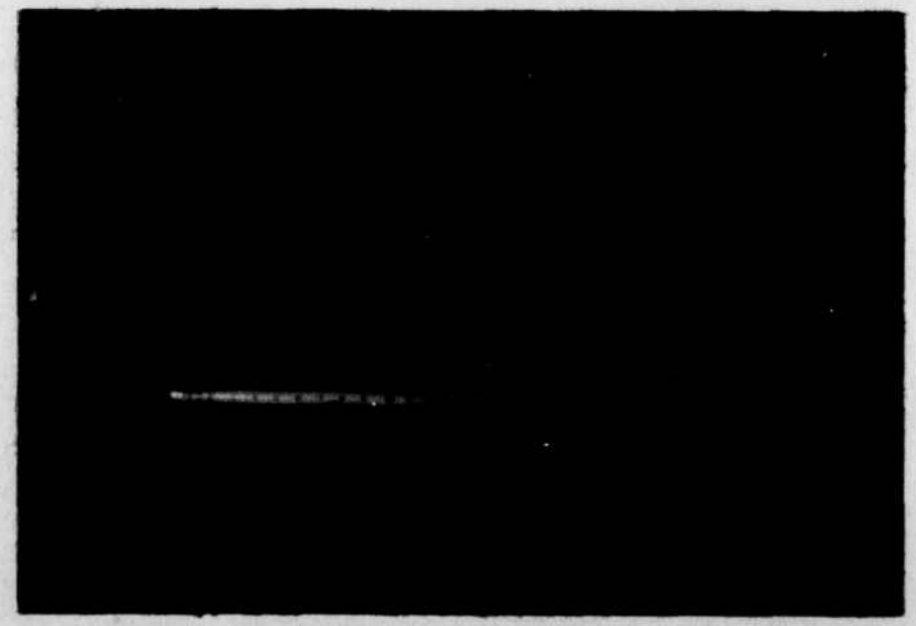
DESIGN LOADS
Live Load: H20-S16 + 15% Impact;
600psf uniformly distributed
30 Ton Truck Crane.

GENERAL NOTES:
This drawing developed in part from NAVFAC Drwg. No. 1242640, 1242641 & 6085846

All piles were given a "swim-by" Level I inspection, piles that are shaded were given a Level II inspection.

+ Channel bottom elevations
Datum MLLW El. 0.00

PHOTOGRAPH 12 PILE 9C AT APPROXIMATELY -20 MLLW, PIER 5002



PHOTOGRAPH 13 PILE 23A AT APPROXIMATELY -30 MLLW, PIER 5002

Since Pier 5002 is in excellent condition, and a portion of it is more than ten years old, it is recommended that another inspection be performed in ten years to determine if deterioration is occurring. This report should be used as a reference base against which to judge future conditions.

4.3 Pier 5003

4.3.1 Description

Pier 5003, the northerly pier at the Naval Submarine Base, is commonly referred to as Dixon Pier. It provides berthing space for submarine support vessels at its outboard end, and provides berthing space for submarines, and miscellaneous small craft.

Pier 5003 was built in 1977. It is approximately 518 feet long and 60 feet wide, with a 30 feet long and 27 feet wide portal crane platform on the south side at the outboard end. The pier is generally constructed of precast concrete vertical and batter piles with a precast concrete pile cap supporting precast concrete panels. A cast in place concrete topping is supported by the precast panels.

The water depth along the pier generally varies from approximately 30 feet at the inboard end to 45 feet at the outboard end.

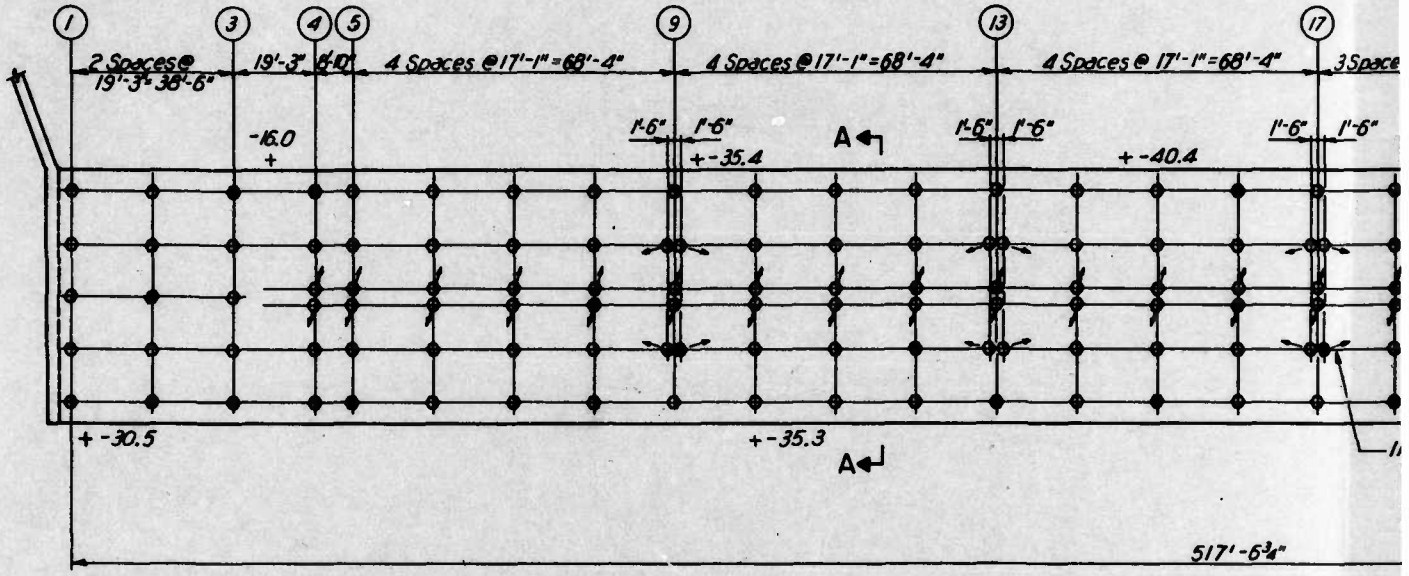
Refer to Figure 6 for a plan of the pier and typical sections showing the general configuration of the structure.

4.3.2 Observed Inspection Condition

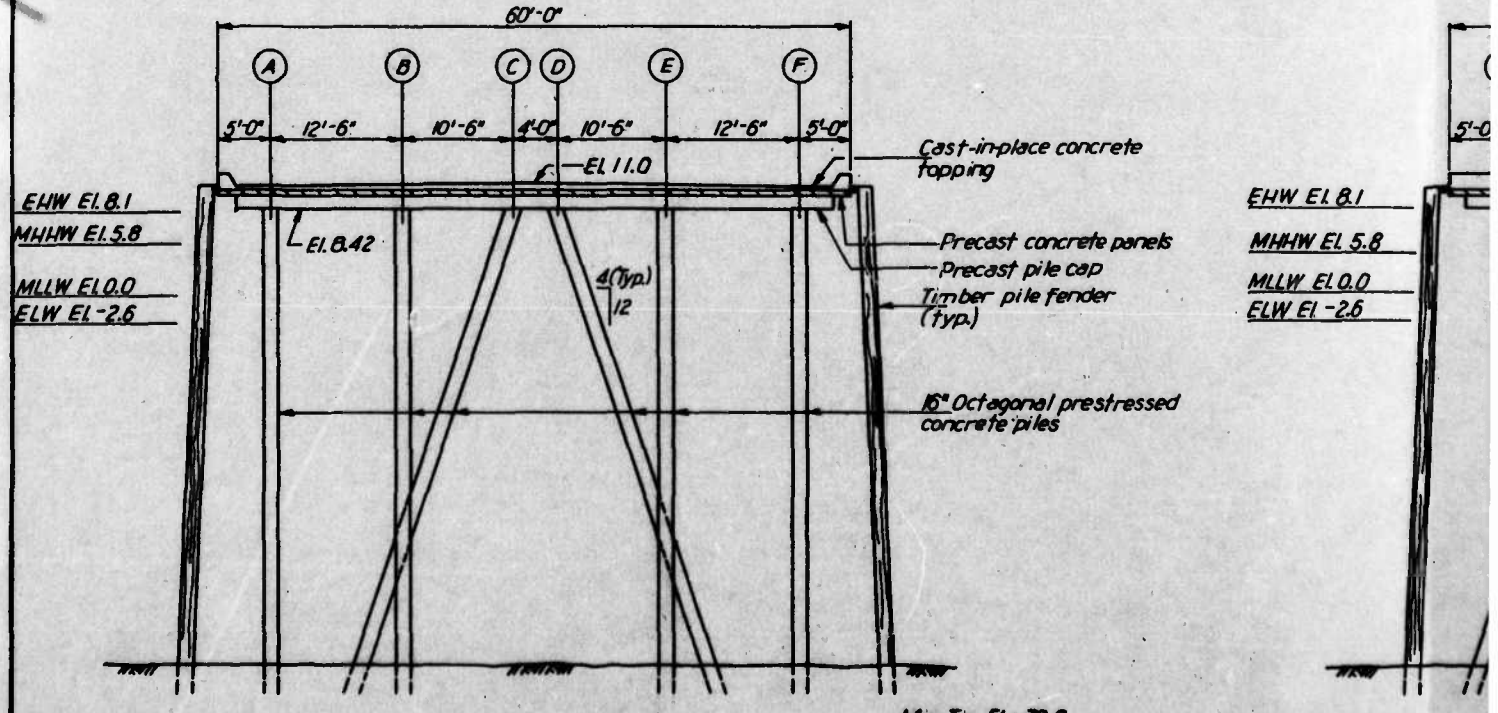
The prestressed concrete piles of Pier 5003 are in excellent condition. When cleaned of marine growth, the concrete appeared sound and the corners were sharp. Refer to Photographs 14 through 18 for views of typical piles.

4.3.3 Structural Condition Assessment

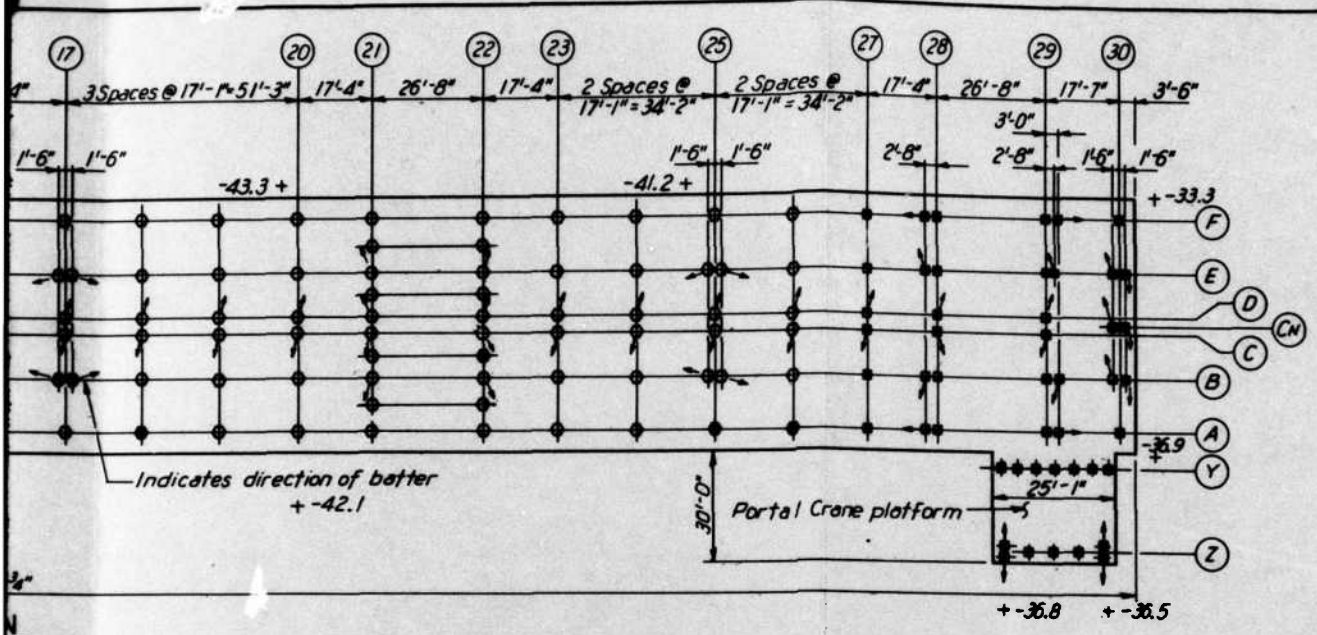
Pier 5003 is in excellent condition. No significant distress or deterioration was found.

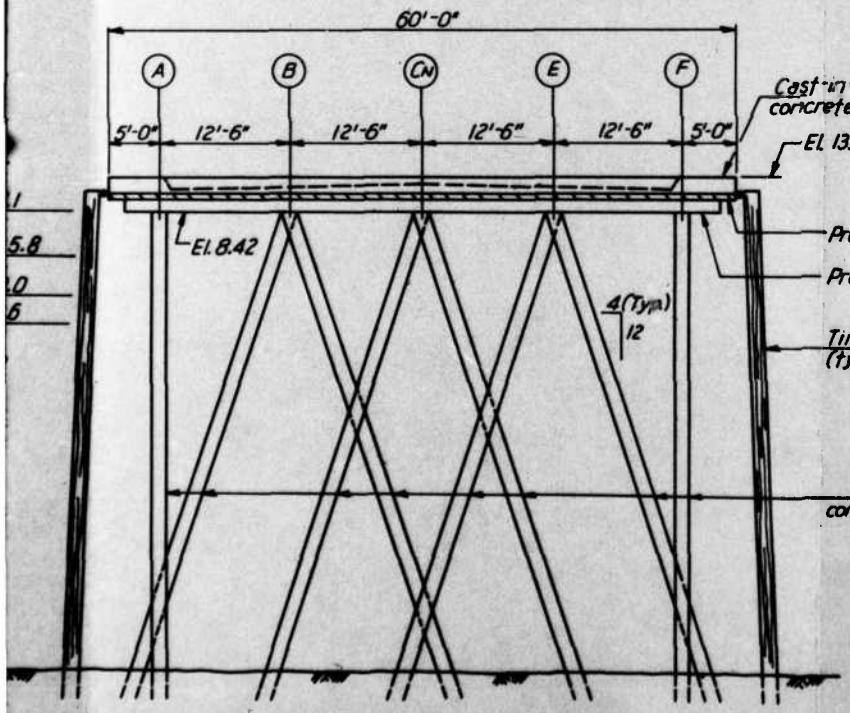


PLAN



SECTION A-A





END ELEVATION BENT 30

DESIGN LOADS
Live Load : H20-S16+15% Impact
600 psf uniformly distributed;
30 Ton Truck Crane.

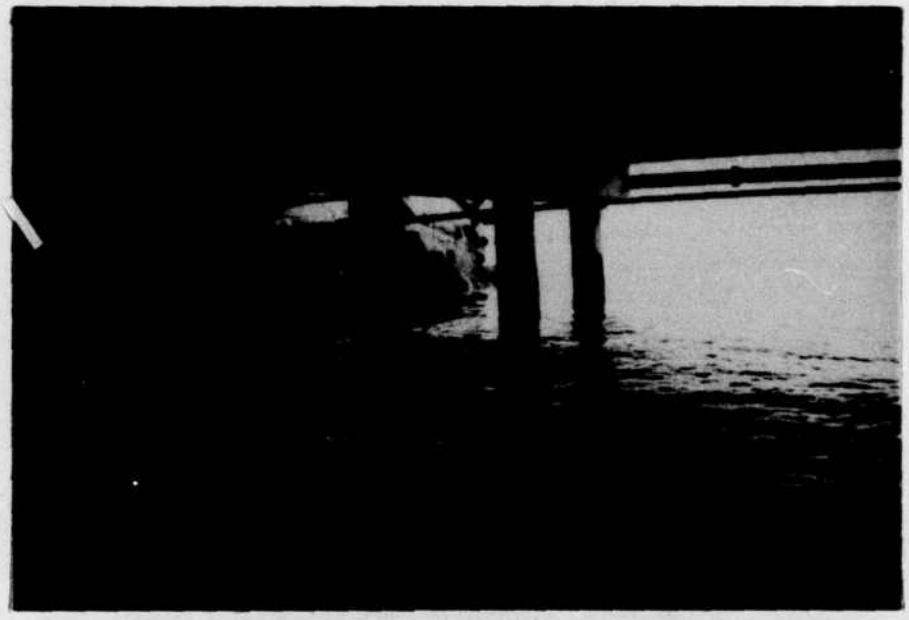
GENERAL NOTES:
This drawing developed in part from NAVFAC Drwg. No. 6064950 & 6064951

All piles were given a "swim-by", Level I inspection. Piles that are shaded were given a detailed, Level II inspection.

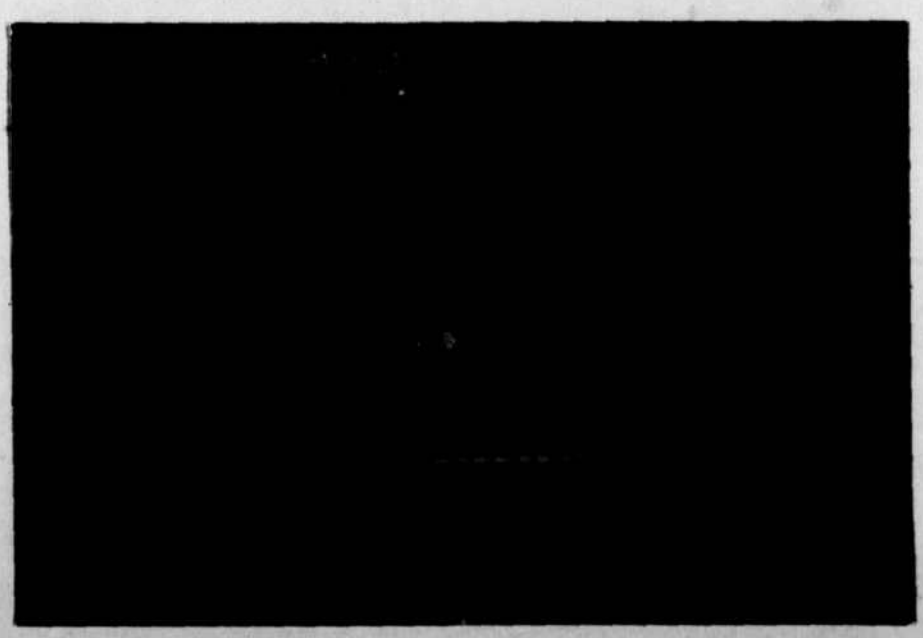
+ Channel bottom elevations
Datum MLLW El. 0.00

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.

NAVAL SUBMARINE BASE SAN DIEGO, CA

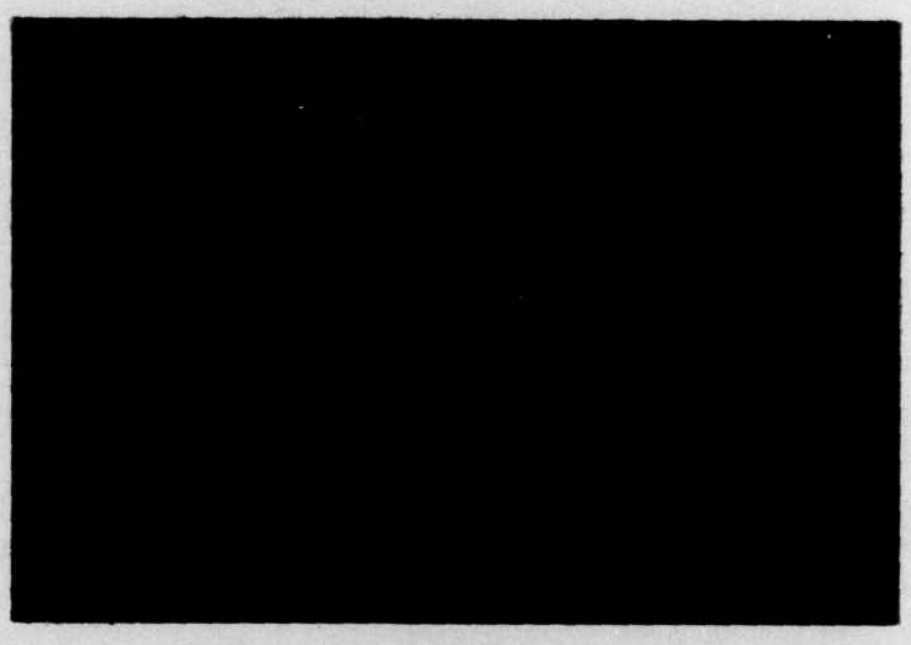


PHOTOGRAGH 14 PILE BENT NUMBER 2, PIER 5003



PHOTOGRAPH 15 PILE 251 AT APPROXIMATELY

PHOTOGRAPH 16 PILE 27A AT APPROXIMATELY -20 MLLW, PIER 5003



PHOTOGRAPH 18 PILE Z5 AT APPROXIMATELY -20 MLLW, PIER 5003

4.3.4 Recommendations

No repairs are warranted at this time.

No reduction from the design live loads indicated on Figure 6 is recommended. Since Pier 5003 is in excellent condition, and it is about five years old, it is recommended that another inspection be performed in ten years to determine if deterioration is occurring. This report should be used as a reference base against which to judge future conditions.

4.4 Bulkhead

4.4.1 Description

The sheet pile bulkhead adjacent to Pier 5002 is approximately 625 ft long. It is constructed of steel sheet piles tied back to a concrete beam supported on timber piles. A concrete cap beam cast atop the sheeting acts as a curb for the pavement behind the bulkhead.

The water depth along the bulkhead varies from zero, where a riprap slope extends above the water at the sheeting, to about 11 ft.

Refer to Figure 7 for a plan of the bulkhead and a typical section showing the general configuration of the structure.

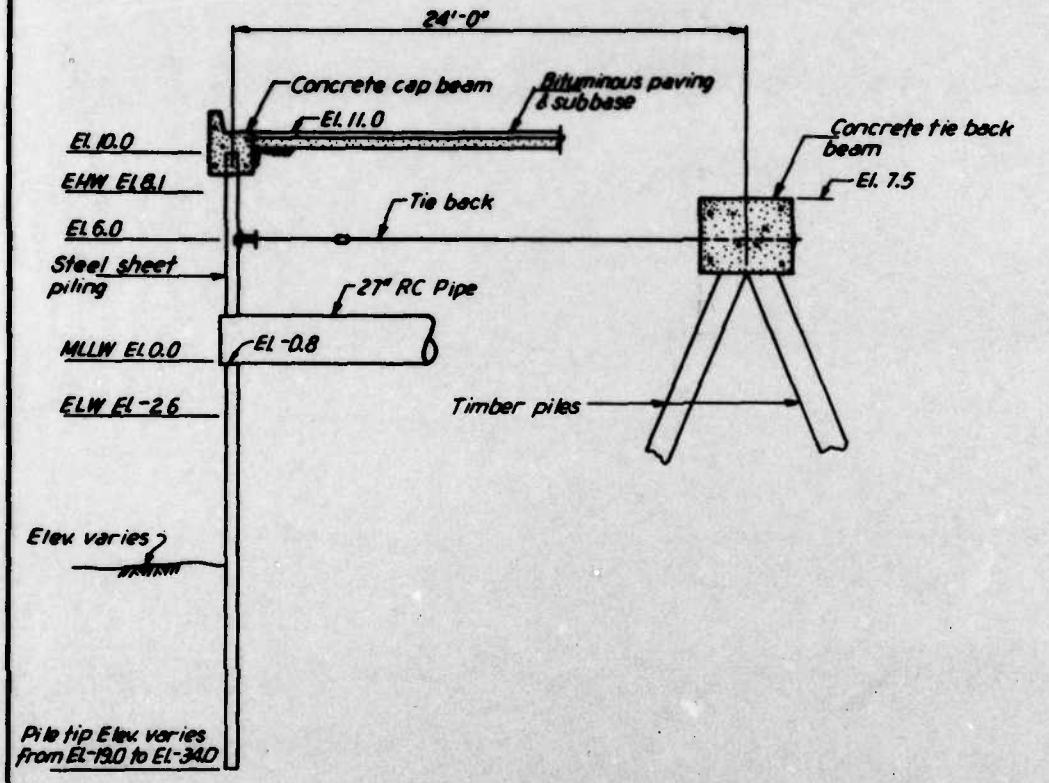
4.4.2 Observed Inspection Condition

The steel sheet pile bulkhead adjacent to Pier 5002 is in excellent condition. There was no visible evidence of significant damage or deterioration.

There was, however, some minor deterioration of the tie rod nuts visible above the waterline, and there were holidays in the protective coating on the steel in the splash zone. (The protective coating is indicated on the design drawings for the facility, but its composition is not specified.)

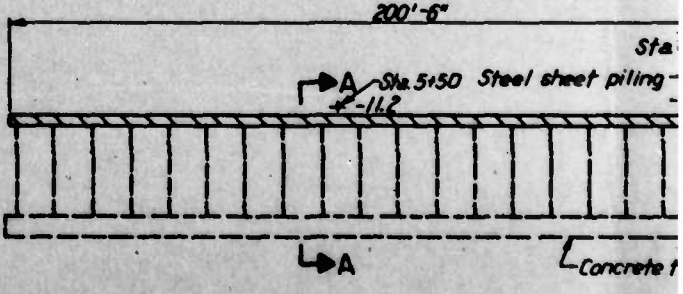
The marine growth on the steel sheet piles was similar to that on the other piles in the facility, but had a thickness of about one-half inch. Beneath the marine growth, the protective coating appeared to be intact.

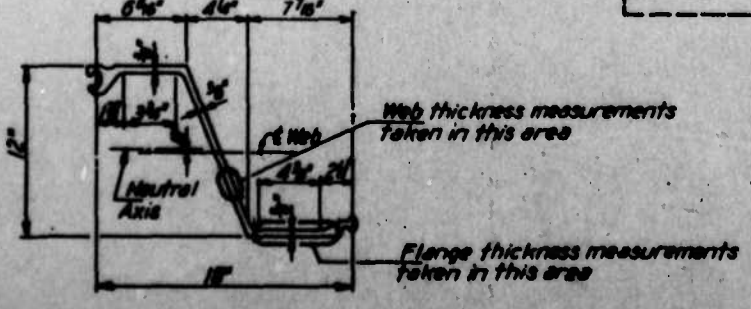
The remaining section of six steel sheet piles was measured ultrasonically. Refer to Figure 7 for the detailed measurements. In general, the thickness of the steel sheeting is greater than or approximately the same as the theoretical thickness of the pile.



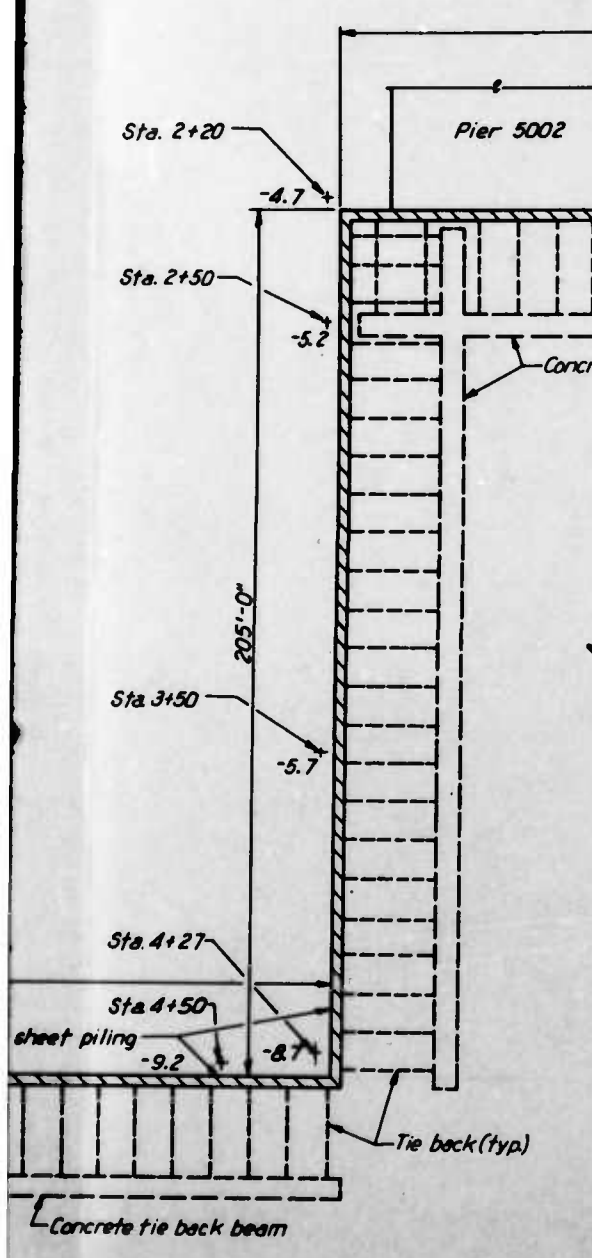
SECTION A-A

San Diego Bay





TYPICAL STEEL SHEET PILE - MZ-27 ⁿ



PLAN

DESIGN LOADS
Live Load:
300 psf uniformly distributed
or Crane outrigger load = 50K

Note:
This drawing developed in part from NAVFAC Drwg. No. 1242650

+ Channel bottom elevation
Datum MLLW El. 0.00

N

ULTRASONIC THICKNESS MEASUREMENTS

Station	Location	Flange Reading				Flange Average	Web Reading				Web Average
0+50	Mudline	.425	.422	.427		.425					
	2' below MLLW	.439	.426	.434	.428	.436					
		.434	.435								
1+50	Mudline	.435	.440	.445	.435	.435	.377	.380	.382	.389	.373
		.441	.432	.432	.388		.365	.370	.359	.370	
	2' below MLLW	.320	.326	.322		.331	.356	.358	.363		.359
		.326	.328				.358	.360	.360		
2+50	Mudline	.410	.388	.439		.439					
	2' below MLLW	.394	.390	.386		.397					
		.397	.408								
3+50	Mudline	.495	.488	.480		.488					
	2' below MLLW	.435	.438	.413	.416	.426					
4+50	Mudline	.512	.500			.512	.379	.368	.359		.406
		.508	.516	.522			.415	.405	.402	.407	
	2' below MLLW	.370	.363	.368		.368					
		.368	.373								
5+50	Mudline	.348	.343	.344		.346					
		.350	.346	.346							
	2' below MLLW	.365	.329	.376		.365					
		.379	.370	.349							

Note:
Theoretical web and flange thickness is ½ inch

4.4.3 Structural Condition Assessment

The steel sheet pile bulkhead is in excellent condition below water. No significant damage or deterioration was found. Measurements in excess of the original theoretical thickness may be due to the variations in fabrication tolerances, the normal accuracy of the thickness measuring device, and the possibility of measuring thickness close to the pile interlock.

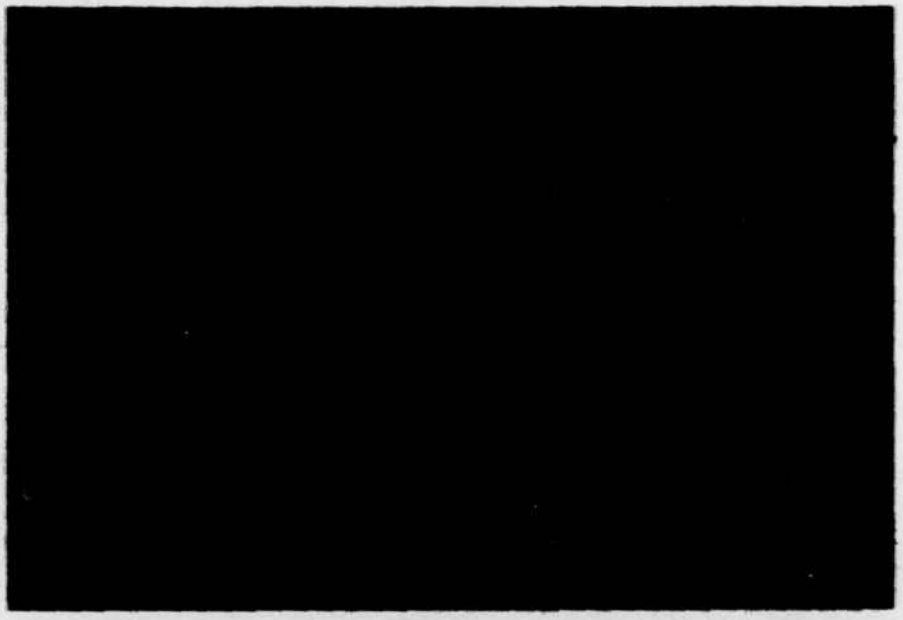
Deterioration of the wall accessories is beginning in the splash zone, but is not structurally significant at this time.

4.4.4 Recommendations

No immediate repairs are warranted at this time. It is recommended, however, that a protective coating be applied to the steel sheet piling, and exposed tie rods and nuts as a part of future preventative maintenance. The coating should extend from about low water to the top of the steel sheeting. As a part of the preparatory work, the steel components should be cleaned by sandblasting. The cleaning and application of the coating could be accomplished for approximately $11,000.

No reduction from the design live loads indicated on Figure 7 is indicated.

It is also recommended that another inspection of the bulkhead be conducted in five years. Particular attention should be given to the steel tie rod nuts in the splash zone at that time.



PHOTOGRAPH 19 INSPECTION OF BULKHEAD

TABLE OF CONTENTS FOR APPENDIX

BIBLIOGRAPHY

1. Regional Development Plan/San Diego Naval Complex; Southern Division, Naval Facilities Engineering Command, p. B1-C32.

REPAIR COST ESTIMATE

Pier 5000

1. Repair pile 23G at connection to pile cap.

Material costs:

New Concrete - 1½ cubic yards	$ 300.00
Reinforcing steel - 100 pounds	50.00
Subtotal	$ 350.00

Labor costs:

Breakout and remove existing concrete deck, pile cap and top portion of pile

2-jackhammermen	$ 480.00
1-compressor & operator	1,000.00
1-highlift & operator	600.00
1-truck & driver	480.00
Subtotal	$ 2,560.00

Form and pour new concrete for deck, pile cap, and pile

2-carpenters & formwork	$ 800.00
1-laborer	110.00
1-concrete finisher	180.00
Subtotal	$ 1,090.00

Total Material and Labor: $ 4,000.00

MAINTENANCE COST ESTIMATES*

I. PIER 5000

Repair piles 59A, 61E, 61F

Material Costs:

Expoxy grout - 10 gallons		$ 500.00
	Subtotal	$ 500.00

Labor Costs:
Chipping cracks to provide at least ½" wide gap for length of crack

2-Divers	$ 1,500.00
1-Hydraulic power unit and operator	850.00
Subtotal	2,350.00
Total Material and Labor	$ 2,850.00
Approximately	$ 3,000.00

II. BULKHEAD ADJACENT TO PIER 5000

Clean and place protective coating on steel sheet piling from M.L.L.W. to bottom of concrete cap (approximately 9 feet).

Material Costs:

Sand	300 C.Y.	$ 1,500.00
Bituminous	120 gal	850.00
	Subtotal	$ 2,350.00

Labor Costs:
Sandblast surface of steel sheet piling and apply waterproofing (Note: Productive labor time will be reduced by tides)

2-Laborers	$ 3,500.00
1-Compressor operator	2,100.00
1-Nozzleman	2,100.00
1-Workboat	800.00
Subtotal	$ 8,500.00
Total Labor and Material	$10,850.00
Approximately	$11,000.00

*Subject to local variations


N
DAT

PHOTOGRAPH 15 PILE 25A AT APPROXIMATELY -25 MLLW, PIER 5003

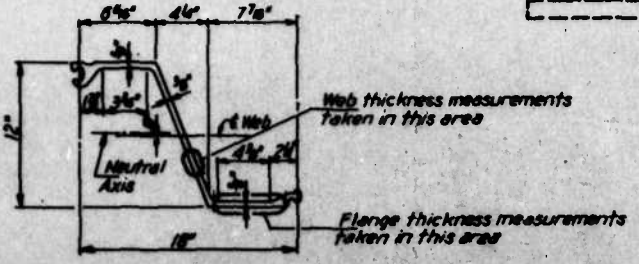
PHOTOGRAPH 17 PILE 30A AT APPROXIMATELY -30 MLLW, PIER 5003

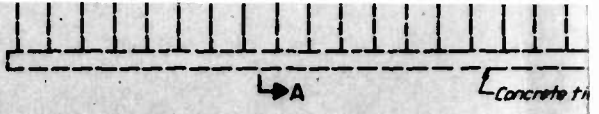
the facility, but its composition is not specified.)

The marine growth on the steel sheet piles was similar to that on the other piles in the facility, but had a thickness of about one-half inch. Beneath the marine growth, the protective coating appeared to be intact.

The remaining section of six steel sheet piles was measured ultrasonically. Refer to Figure 7 for the detailed measurements. In general, the thickness of the steel sheeting is greater than or approximately the same as the theoretical thickness of the pile.

Refer to Photograhs 19 and 20 on Page 4-26 for views of the inspection and measurement procedure.

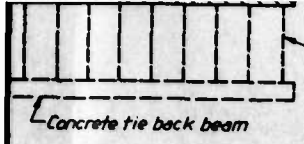




TYPICAL STEEL SHEET PILE-MZ-27 *

* Now refered to as PZ-27

Note:
Original pile section not given in reference drawings; pile section derived from field measurements.



PLAN

2+50	Mudline	.410	.388	.439		.439				
	2' below MLLW	.394	.393	.386		.397				
		.397	.400							
3+50	Mudline	.495	.488	.480		.488				
	2' below MLLW	.435	.438	.413	.416	.426				
4+50	Mudline	.512	.508			.512	.370	.360	.389	.406
		.509	.518	.522			.415	.405	.402 .407	
	2' below MLLW	.370	.363	.368		.368				
		.366	.373							
5+50	Mudline	.339	.343	.344		.346				
		.350	.345	.346						
	2' below MLLW	.365	.329	.376		.365				
		.379	.370	.369						

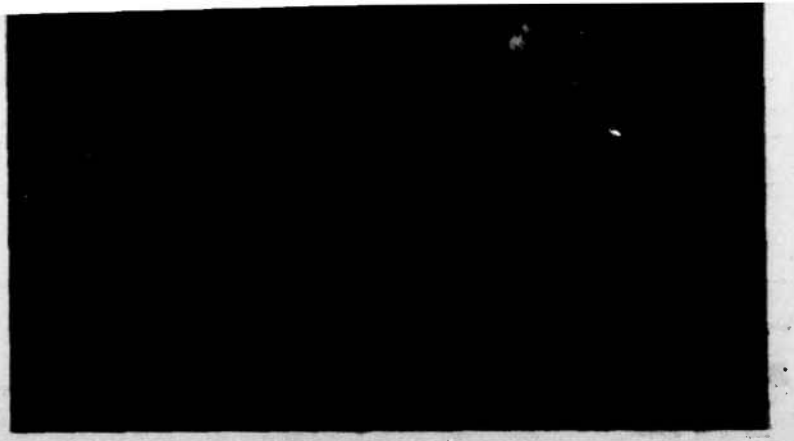
Note:
Theoretical web and flange thickness is $\frac{3}{8}$ inch.

CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.
NAVAL SUBMARINE BASE SAN DIEGO, CA
BULKHEAD

2

4-84

It is also recommended that another inspection of the bulkhead be conducted in five years. Particular attention should be given to the steel tie rod nuts in the splash zone at that time.



PHOTOGRAPH 20 UNDERWATER THICKNESS MEASUREMENT OF STEEL SHEET PILE BULKHEAD

Total Material and Labor:	$ 4,000.00